FACULTY OF SCIENCE

DEPARTMENT BOTANY AND PLANT BIOTECHNOLOGY

BIO1A1E

BIOLOGY EXTENDED 1A

APK CAMPUS

NOVEMBER EXAM

6 NOVEMBER 2015

DATE:	**6 NOVEMBER 2015**
SESSION:	**8H30-11H30**
ASSESSOR:	**MS J. WILLIAMSON**
INTERNAL MODERATOR:	**DR. A. NEL**
DURATION:	**3 HOURS**
TOTAL MARKS:	**150**

NUMBER OF PAGES: 14 PAGES

Please read the following instructions carefully:

1. Answer all the questions in the question paper.
2. Answer ALL of the questions in the test book.
3. Work neatly
4. Read your questions carefully.
5. Good Luck.

QUESTION 1 **[20]**

Choose the alternative that best completes the statement or answers the question. Only write down the correct letter next to the question number in your answer book.

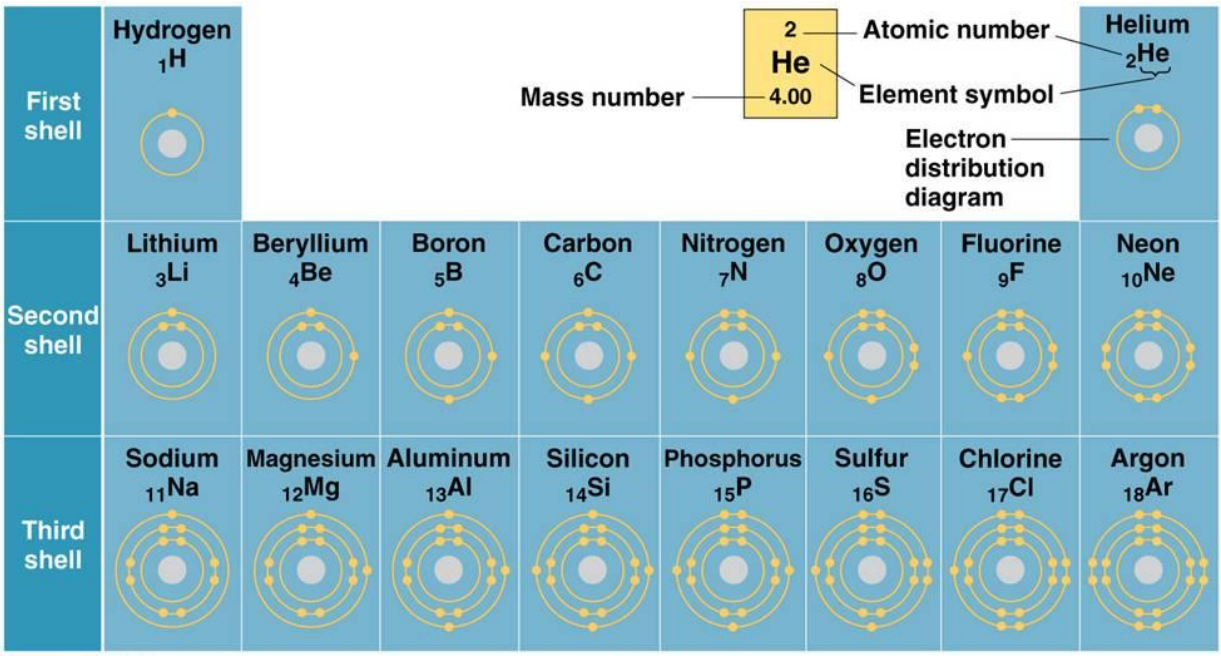
1.1 What is the correct order (from small to large)?

A. Cells, organelles, organ system, community, ecosystems
B. Molecules, organism, population, communities, biosphere
C. Molecules, cells, tissues, ecosystems, communities
D. Organelles, cells, population, biosphere, ecosystems
E. Cells, organs, population, ecosystems, communities

1.2 The idea that form and function are related would not be exemplified by which of the following examples?

A. Cells in the intestinal lining of vertebrates have many small projections that increase the surface area for absorption of nutrients.
B. Plants that live in dry areas have large roots for absorbing water.
C. Seeds that are dispersed by wind are very light.
D. Fish that swim rapidly have bodies that are streamlined.
E. none of the above

1.3 Based on the periodic table shown below, which elements will most likely form an ionic bond?



A. Li and F
B. C and O
C. N and O
D. Si and Cl
E. all of the above

1.4 Titanium has an atomic number of 22. How many protons, neutrons, and electrons are in an isotope of titanium with mass number of 48?

A. p - 22, n - 26, e - 22
B. p - 11, n - 26, e - 11
C. p - 11, n - 11, e - 70
D. p - 11, n - 22, e - 48
E. p - 22, n - 22, e – 48

1.5 Carbon is an unusual atom in that it can form multiple bonds. Which statement is NOT true?

A. A carbon-to-carbon cis double bond is the type found in nature and is associated with cardiovascular health.
B. A carbon-to-carbon trans double bond is made artificially in food processing and is associated with poor cardiovascular health.
C. Multiple carbon-to-carbon double bonds located near each other can absorb light, so they are found in molecules in the eye or in chloroplasts.
D. Multiple carbon-to-carbon bonds are stronger than single bonds.
E. Saturated fats are those that have a carbon-to-carbon double bond and are associated with good health.

1.6 Which type of molecule always contains phosphate groups?

A. Carbohydrates
B. Lipids
C. Proteins
D. Nucleic acids
E. None of the above

1.7 Which cellular structure is common to all three (3) domains of life?

A. Nucleus
B. Endoplasmic reticulum
C. Mitochondria
D. Phospholipid bilayer cell membrane

E. endocytotic vesicles

1.8 What is the correct order of the exocytosis or secretion pathway?

A. Rough ER, endosome, Golgi, smooth ER.
B. Rough ER, Golgi, smooth ER, plasma membrane.
C. Smooth ER, rough ER, exocytosis, Golgi.
D. Rough ER, Golgi, transport vesicle, plasma membrane.
E. Rough ER, Golgi, endosome, plasma membrane, transport vesicle.

1.9 Which of the following molecules will diffuse most quickly across a lipid bilayer membrane?

A. H_2O
B. O_2
C. $H_2PO_4^-$
D. glucose
E. Na^+

1.10 Cells (e.g., bacteria) are taken up by other cells (e.g., an immune cell) by which of the following processes?

A. Pinocytosis
B. Exocytosis
C. Receptor-mediated endocytosis
D. Phagocytosis
E. Facilitated diffusion

1.11 Cellular respiration can best be described as _____

A. using energy released from breaking high-energy covalent bonds in organic molecules to force ATP formation from ADP and phosphate.
B. taking electrons from food and giving them to phosphate to make ATP.
C. taking electrons from food and giving them to oxygen to make water and using the energy released to drive ATP formation.
D. converting higher-energy organic molecules to lower-energy organic molecules and using the energy released to drive ATP formation.

1.12 Newborn mammals have a specialized organ called brown fat, where cells burn fat to CO_2 without capturing the energy to reduce electron carriers or drive ATP formation. How can this energy be used instead?

A. To synthesize glucose from CO_2.

B. To directly power muscle contraction.
C. To provide energy for endergonic biosynthetic reactions.
D. To generate heat.

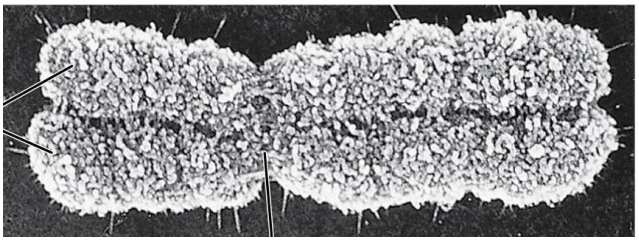
1.13 Which of the following INCORRECTLY matches a process with its typical location?

A. Oxygen gas is produced—the soluble space surrounded by the thylakoid membranes.
B. Activated chlorophyll donates an electron — in the thylakoid membranes.
C. NADPH is oxidized to NADP—the stroma of the chloroplast
D. ATP is produced—the space between the two (2) chloroplast envelope membranes.
E. RUBISCO catalyzes carbon fixation — the stroma of the chloroplast.

1.14 In a protein complex for the light reaction (a reaction center), energy is transferred from pigment molecule to pigment molecule, to a special chlorophyll a molecule, and eventually to the primary electron acceptor. Why does this occur?

A. The action spectrum of that molecule is such that it is different from other molecules of chlorophyll.
B. The potential energy of the electron has to go back to the ground state.
C. The molecular environment lets it boost an electron to a higher energy level and also to transfer the electron to another molecule.
D. Each pigment molecule has to be able to act independently to excite electrons.
E. These chlorophyll a molecules are associated with higher concentrations of ATP.

1.15 At what stage of the cell cycle would you see a chromosome that looks like the one (1) in the diagram below?



A. G1
B. G2
C. M
D. S

1.16 Which of the following best describes the kinetochore?

A. A structure composed of several proteins that associate with the centromere region of a chromosome and that can bind to spindle microtubules.

B. The centromere region of a metaphase chromosome at which the DNA can bind with spindle proteins.
C. The array of vesicles that will form between two dividing nuclei and give rise to the metaphase plate.
D. The ring of actin microfilaments that will cause the appearance of the cleavage furrow.
E. The core of proteins that forms the cell plate in a dividing plant cell.

1.17 John, age 47, has just been diagnosed with Huntington's disease, which is caused by a dominant allele. His daughter, age 25, now has a 2-year-old son. No one else in the family has the disease. What is the probability that the daughter will contract the disease?

A. 0%
B. 25%
C. 50%
D. 75%
E. 100%

1.18 ABO blood type in humans exhibits codominance and multiple alleles. What is the likelihood of a type A father and a type A mother having a type O child?

A. It is impossible.
B. 25% if both parents are heterozygous.
C. 50% if both parent are heterozygous.
D. 25% if only the father is heterozygous.
E. 25% if only the mother is heterozygous.

1.19 How do the leading and the lagging strands differ?

A. The leading strand is synthesized in the same direction as the movement of the replication fork, whereas the lagging strand is synthesized in the opposite direction.
B. The leading strand is synthesized at twice the rate of the lagging strand.
C. The lagging strand is synthesized continuously, whereas the leading strand is synthesized in short fragments that are ultimately stitched together.
D. The leading strand is synthesized by adding nucleotides to the 3' end of the growing strand, whereas the lagging strand is synthesized by adding nucleotides to the 5' end.

1.20 Who conducted the X-ray diffraction studies that were key to the discovery of the structure of DNA?

A. Griffith
B. Franklin
C. Meselson and Stahl
D. Chargaff
E. McClintock

QUESTION 2 **[20]**

Give the correct biological term for each of the following definitions. Only write down the correct term next to the appropriate question number in your answer book.

2.1 The property of life shown by pygmy horses who camouflage themselves in their environment, this adaption evolved over many generation by reproductive success of those individuals with heritable traits best suited to their environment.

2.2 Organisms which act as recyclers, changing complex matter into simpler mineral nutrients.

2.3 Substances that have characteristics that differ from their elements.

2.4 The deficiency of this element prevents production of thyroxin, resulting in the formation of a goiter.

2.5 The organic molecule used as a main fuel source for cellular work and used as raw materials to manufacture other organic molecules.

2.6 The bond that joins two (2) carbohydrate monomers.

2.7 The organelle containing digestive enzymes not found in a plant cell.

2.8 The part of the cell which support the cell's shape and are involved in motility.

2.9 The phenomenon that occurs in a hypertonic environment, where a plant cell loses water and eventually, the membrane pulls away from the wall.

2.10 The process by which fluids are taken into small vesicles into the cell.

2.11 The quantity of heat required to raise the temperature of 1 kilogram (kg) of water by $1^{o}C$.

2.12 The co-enzyme involved with the citric acid cycle of a cell.

2.13 Prokaryotes that use inorganic chemicals as their energy source.

2.14 Tiny pores in the leaves of a plant.

2.15 Reproduction method which involves inheritance of all genes from one (1) parent.

2.16 Cancer which arise in external or internal body coverings.

2.17 Alternative versions of genes.

2.18 A common fatal genetic disease in the United States, resulting in excessive thick mucus secretions.

2.19 The beginning of the DNA code needed to be recognized at the start of protein synthesis.

2.20 The amount of hydrogen bonds between Guanine and Adenine in a DNA molecule.

QUESTION 3 **[11]**

3.1 In the diagram below, which property of life is portrayed by the Lemur? Explain your answer. (2)

3.2 Why are cells said to be at the level at which the properties of life emerge, the lowest level that perform all activities required for life? (5)

3.3 Name and distinguish between the two (2) basic types of cells with regard to complexity of the cells. (8 x ½ = 4)

QUESTION 4 **[11]**

4.1. What type of bond is very prevalent in lipids and gives lipids their properties? (1)

4.2 Name the four (4) most commonly found elements in the human body. Which one of these four (4) has the most valence electrons? (5)

4.3 Water shows high cohesion and surface tension and can absorb large amounts of heat because of large numbers of which bonds between water molecules? Draw a diagram to show how water molecules bond via this bond. (5)

QUESTION 5 **[11]**

5.1 Study the following structural formulas and answer the questions that follow.

Diagram A

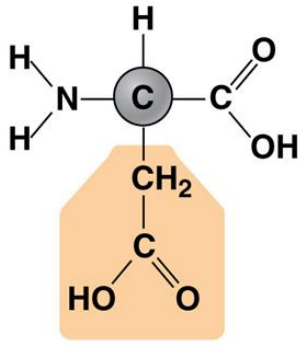
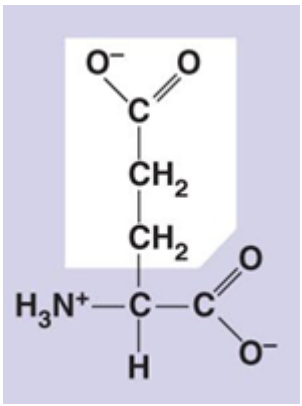


Diagram B

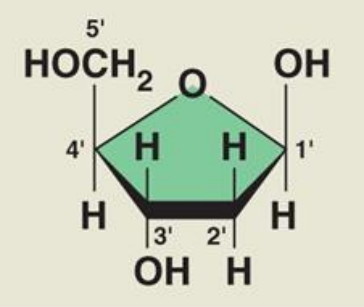


5.1.1 To which organic molecules do the molecules represented by Diagrams A and B belong? Give two (2) reasons for your answer. (2)

5.1.2 Is the molecule represented by Diagram A, hydrophobic or hydrophilic and polar or nonpolar? Give a reason for your answers. (3)

5.1.3 Is the molecule represented by Diagram B, acidic or basic? Give a reason for your answer. (2)

5.2 Study the diagram of the structural formula of a sugar below.



5.2.1 According to the amount of carbons in the sugar in the diagram, what sugar is represented by the diagram? (1)

5.2.2 Name the nucleic acid which contains this sugar? (1)

5.2.3 What other molecules are connected to this sugar to make up the nucleic acid answered in question 5.2.2? (2)

QUESTION 6 **[11]**

6.1 In developed countries over the last 50 years, there has been a decline in human sperm quality. Give possible reasons for this. (2 x ½ = 1)

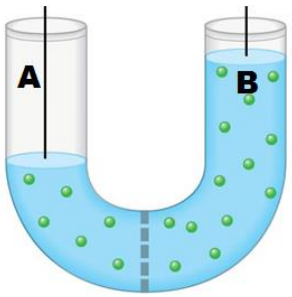
6.2 How do adjacent cells communicate, interact, and adhere to one another? (5)

6.3 Eukaryotic cell structures can be grouped on the basis of four (4) functions. Briefly mention these basic functions. (4)

6.4 Why are peroxisomes important to a cell? (1)

QUESTION 7 **[11]**

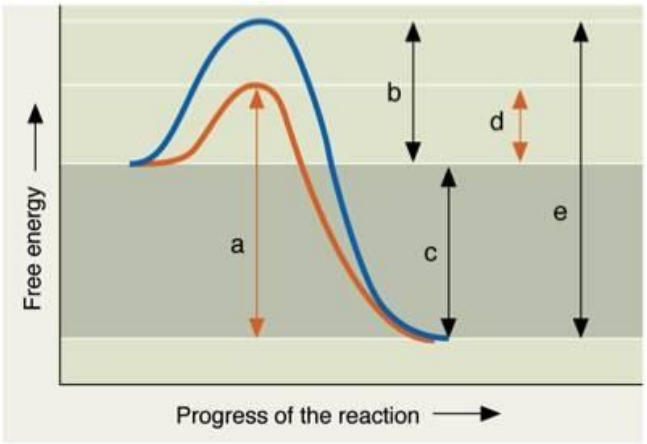
7.1 Study the diagram of a U-tube with 50% sugar solution in side A, separated by a selectively permeable membrane that only allows water to pass through, and a 70% sugar solution in side B.



7.1.1 What process will occur across the selectively permeable membrane? (½)

7.1.2 Explain and briefly discuss what will happen in the next few minutes if this tube is left undisturbed. (5)

7.2 Study the energy diagram below and answer the questions that follow.



7.2.1 Supply labels for a, b, c, d and e. (5)

7.2.2 Which of the energy changes would be the same in both the enzyme-catalysed and uncatalyzed reactions? (½)

QUESTION 8 **[11]**

8.1 Supply an equation to explain the redox reaction that takes place during cellular respiration. (8 x ½ = 4)

8.2 Draw a diagram to only explain the first phase of cellular respiration. (12 x ½ = 6)

8.3 Which phase of cellular respiration produces the most energy and where does this phase take place in the cell? (2 x ½ = 1)

QUESTION 9 **[11]**

9.1 Name and draw a labelled diagram to clarify the events that takes place during the second phase of photosynthesis. (16 x ½ = 8)

9.2 What end product are formed during the first phase of photosynthesis? (3)

QUESTION 10 **[11]**

10.1 Briefly describe how the cell cycle is controlled. (10 x ½ = 5)

10.2 Study the following diagrams and answer the questions that follow.

Diagram A

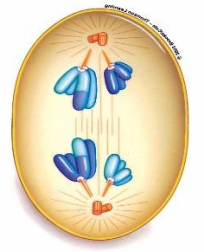
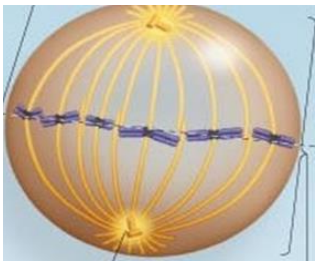


Diagram B



10.2.1 Name the respective cell division processes and phases of the above diagrams. (4)

10.2.2 Give reasons for your answers in question10.2.1. (2)

QUESTION 11 **[11]**

11.1 Tim and Jan both have freckles, but their son Mike does not. With the aid of a punnet square explain how this is possible. If Tim and Jan have two (2) more children, what is the probability that both will have freckles? (Hint: Use the letter "r/R" as the gene that codes for freckles or no freckles". (10 x ½ = 5)

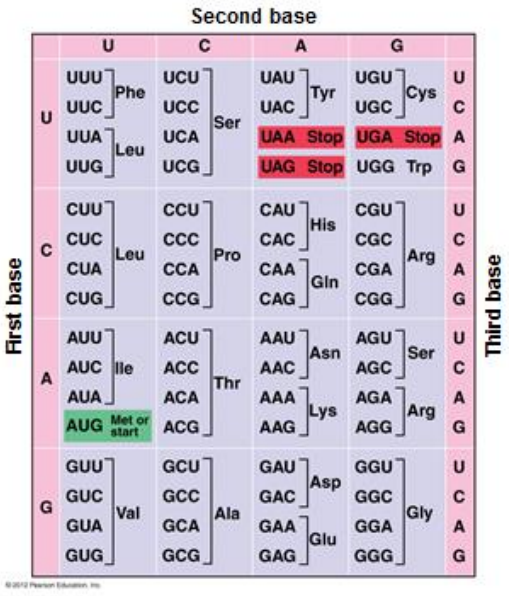
11.2 In humans the gene from normal blood clotting, H, is dominant to the gene for hemophilia, h. This is a sex-linked trait found on the X chromosome. A woman with normal blood clotting has four (4) children. They are a normal son, a hemophiliac son and two (2) normal daughters. The father has normal blood clotting. What is the probable genotype for each member of the family? (6)

QUESTION 12 **[11]**

12.1 From the DNA strand below, write down the expected mRNA strand and protein strand that would result. (use the table below) (6)

DNA: ACTACGGGCATCGTCCCATTGCCC

Figure 10.8A



12.2 For the process of Mitosis to occur, it is important to make sure each new daughter cell has the same genetic material as the original parent cell, therefor during interphase a very important process has to take place.

12.2.1 Name the very important process referred to in the above statement (12.2). (1)

12.2.2 There are a few enzymes which assist in the process answered in question 3.4.1. What are the functions of the following enzymes is this process?

a. Topoisomerase (1)

b. Helicase (2)

c. DNA ligase (1)

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